



House of Commons  
Science and Technology  
Committee

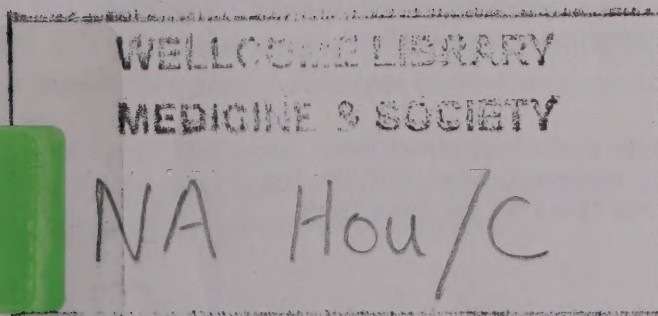
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**Science in the Met  
Office: Government  
Response to the  
Committee's  
Thirteenth Report of  
Session 2010–12**

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**First Special Report of  
Session 2012–13**

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## Science and Technology Committee

The Science and Technology Committee is appointed by the House of Commons to examine the expenditure, administration and policy of the Government Office for Science and associated public bodies.

### Current membership

Andrew Miller (*Labour, Ellesmere Port and Neston*) (*Chair*)  
Caroline Dinenage (*Conservative, Gosport*)  
Gareth Johnson (*Conservative, Dartford*)  
Stephen Metcalfe (*Conservative, South Basildon and East Thurrock*)  
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Graham Stringer (*Labour, Blackley and Broughton*)  
Hywel Williams (*Plaid Cymru, Arfon*)  
Roger Williams (*Liberal Democrat, Brecon and Radnorshire*)

The following members were also members of the committee during the parliament:

Gavin Barwell (*Conservative, Croydon Central*)  
Gregg McClymont (*Labour, Cumbernauld, Kilsyth and Kirkintilloch East*)  
Stephen McPartland (*Conservative, Stevenage*)  
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### Powers

The Committee is one of the departmental Select Committees, the powers of which are set out in House of Commons Standing Orders, principally in SO No.152. These are available on the Internet via [www.parliament.uk](http://www.parliament.uk)

### Publications

The Reports and evidence of the Committee are published by The Stationery Office by Order of the House. All publications of the Committee (including press notices) are on the Internet at <http://www.parliament.uk/science>. A list of reports from the Committee in this Parliament is included at the back of this volume.

The Reports of the Committee, the formal minutes relating to that report, oral evidence taken and some or all written evidence are available in printed volume(s).

Additional written evidence may be published on the internet only.

### Committee staff

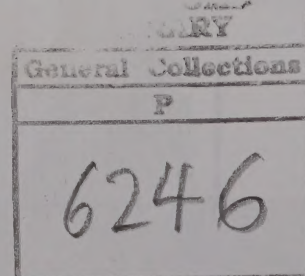
The current staff of the Committee are: Dr Stephen McGinness (Clerk); Dr Farrah Bhatti (Committee Specialist); Xameerah Malik (Committee Specialist); Darren Hackett (Senior Committee Assistant); Julie Storey (Committee Assistant); Henry Ayi-Hyde (Committee Office Assistant); and Nick Davies (Media Officer).

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# First Special Report

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On 21 February 2012 the Science and Technology Committee published its Thirteenth Report of Session 2010–12, *Science in the Met Office* [HC 1538]. On 27 April 2012 the Committee received a memorandum from the Government which contained a response to the Report. The memorandum is published as appendix to this Report.

## Appendix: Government response

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The Government welcomes the Science and Technology Committee's report on Science in the Met Office and the Committee's positive assessment that the Met Office is a world-leading institution underpinned by robust science.

The free at point of use forecasts and warnings the Met Office provide are trusted by the nation and enable people to make informed decisions. In times of hazardous weather the Met Office's warnings enable the resilience community to prepare and respond, helping to protect life, property and critical national infrastructure and reduce economic impacts.

The UK is a leader in climate science research and modelling and the Met Office through the Met Office Hadley Centre is the focal point of this UK capability. Government has a core strategic requirement for climate advice and information and values the service provided by the Met Office.

The Government welcomes the collaborative approach the Met Office is taking to providing services and the role it plays in pulling through investment in science for the benefit of the UK.

The Met Office will continue to strive to build upon this excellent foundation. Further advances will come from continued scientific research coupled with terrestrial and satellite observation networks and high performance supercomputing. The Government recognises the benefits which come from taking a strategic approach to the provision of services and will seek to ensure a sustainable future for Met Office science.

Responses to specific conclusions and recommendations from the Committee are provided below.

### Ownership

**1. We welcome the Minister's comment that the Government has no plans to privatise the Met Office and agree with him that it would be deeply irresponsible to do so on the grounds of the need to fill a hole in the Government's coffers.**

As the Committee points out, there is no current intention to privatise the Met Office. The Government does however, expect the Met Office to develop its commercial services and this could involve private sector partners.



**2. We consider it too early to comment in detail on the Met Office's move from the Ministry of Defence (MOD) to the Department for Business, Innovation and Skills (BIS). However, we welcome the potential for closer links between the Met Office and the research base, as well as the opportunity for the Met Office to develop its commercial activities further.**

The Met Office's world class weather forecasting and climate services are a practical example of how knowledge supports growth. As the Committee highlights, the move of the Met Office to BIS will enhance the Met Office's already flourishing partnerships with the UK's research and innovation infrastructure helping to deliver even greater benefit from the UK's investment in science. There will also be new opportunities for collaboration with key directorates.

The Met Office is part of the wider science family, both in the UK and internationally. It has a world-leading, in-house Research & Development capability, and collaborates strongly with the UK Research Base. The Met Office, for example, has a close working relationship with the Natural Environment Research Council (NERC). Through the Joint Weather and Climate Research Programme, NERC and the Met Office collaborate to address critical gaps in the existing national portfolio of weather and climate research and pull through NERC science into operational use and innovative products and services.

Currently, NERC is actively working with the Met Office on new approaches to provide the environmental services needed by the nation to support resilience and growth. Examples include collaboration in the Natural Hazards Partnership<sup>1</sup> which provides round-the-clock, trusted services and advice to the resilience community, and the emerging Environmental Science to Service Partnership<sup>2</sup>, which aims to harness the nation's investment in environmental science to the benefit of society, business and government.

In addition, the Met Office's move to BIS, along with Ordnance Survey and Land Registry marked a significant step towards establishing a Public Data Group (PDG). This brings together a number of organisations, providing an opportunity to align the way they manage and release public data for use and re-use. The Government believes this is the best way to realise the social and economic value generated by the use and re-use of core reference data. The creation of the Data Strategy Board (DSB), the main customer of the PDG, will help government have a more consistent and joined up voice in terms of their needs for data and services from the Met Office.

## **Contracts and Customer Relationships**

**3. As a matter of urgency, the Government should ensure that its Customer Service Agreements (CSAs) with the Met Office are signed and that these CSAs are truly multi-year agreements. Furthermore, we recommend that the Government sets out its minimum funding commitment to the Met Office for each year of the current Spending Review period by the end of this financial year.**

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<sup>1</sup> Other BIS agencies which are members of this partnership are the UK Space Agency and Ordnance Survey

<sup>2</sup> Ordnance Survey are also a member of this partnership and NERC is represented through the British Geological Survey and the Centre for Ecology and Hydrology.



The Government recognises that there are benefits that can arise from multi-year agreements.

Taking Met Office work with Ministry of Defence (MOD) as an example, having the ability to look further forward would enable the Met Office to contribute to strategic initiatives associated with the development of the Joint Force Command structure and the broader development of Geospatial Information and Intelligence. Similarly, it will also allow planning to respond to Strategic Defence and Security Review, Planning Round measures and the post 2014 drawdown in Afghanistan while delivering efficiencies and maintaining service outputs. The ability to ensure change processes can be implemented without impacting on the daily defence support requirement must be maintained however. MOD will look at the options for multi-year agreements with the Met Office as a means to provide more certainty on funding levels.

The Public Weather Service (PWS) CSA is in the process of being updated and re-signed to capture the Departmental change from MOD to BIS. The CSA price has been agreed up to the end of the Spending Review period (2014/15) and includes an indicative price for 2015/16. As stated in the DSB terms of reference, the DSB will provide expert advice to ministers for subsequent Spending Review negotiations. To this end the DSB will work with central government to ensure the current and new contracts between them and members of the PDG maximise the value for government and provide value for money. The DSB will work with central government in any reviews of current contracts and negotiations on future contracts<sup>3</sup>.

BIS, DECC and Defra are working together to finalise a Memorandum of Understanding (MOU) for the Met Office Hadley Centre Climate Programme. This will be signed shortly and agrees funding for the programme for three years. The CSA between the Met Office and Defra has been in place since 2006 and includes a research framework agreement, as well as such services as the provision of weather-related information and expertise in preparing for emergencies. This will be reviewed in light of the new MOU for the Met Office Hadley Centre Climate Programme.

**4. It is our view that the Hadley Centre Climate Programme (HCCP) should be managed by a single Government department, as previously recommended by the Government Chief Scientific Adviser. A less satisfactory alternative would be for the Government to ensure that the Memorandum of Understanding between DECC and Defra is signed as a matter of urgency.**

The UK is a leader in climate science research and modelling and the Met Office through the Met Office Hadley Centre is the focal point of this UK capability, and recognised as having world leading expertise in this field. DECC and Defra have core strategic needs for climate data, information and advice and will continue funding the Met Office Hadley Centre Climate Programme. BIS, DECC and Defra have worked together on a Memorandum of Understanding (MOU) that will be signed shortly. The Government considered if there was a requirement to move towards management by a single

<sup>3</sup> The HCCP work is not part of PWS and these arrangements. It is funded and managed through the MOU between DECC, Defra and BIS as described below. A DECC representative will sit on the Government officials forum of the DSB to ensure dialogue. Should DECC, BIS and Defra wish to make use of the DSB to assist in the development of their next round of contracting for HCCP in 2015, they are encouraged to do so.



Government department and concluded that the current model offered a more robust funding mechanism and it better reflects customers' needs for climate science and evidence. This arrangement will be kept under review and considered by the Programme Board when it defines the on-going programme requirements towards the end of the initial term of the MoU in 2015.

**5. We recommend that the Government and the Met Office reassess whether the existing mechanisms intended to support a strong customer relationship between the Met Office and departments such as MOD, DECC and Defra are effective. Specifically, we invite the Government and the Met Office to consider, and report back to us, on whether there is a need for a Defence Customer Group and a Hadley Centre Climate Programme Customer Group, analogous to the current Public Weather Service Customer Group. One of the benefits of introducing these new customer-focussed groups would be that scrutiny of Met Office science could be streamlined under one review group, as we discuss later in paragraph 25.**

The Government does not consider that an additional Defence Customer Group is required at this time. The MOD and Met Office currently already have a time tested mechanism to capture the meteorological and oceanographic requirements for Defence which engages with a wide cross-section of the operations community who consider the detail for the forthcoming period. This process will be revised and the terms of reference are refined to ensure that they also consider wider strategic drivers and longer term requirements. This will ensure that MOD is obtaining best value for money, setting and measuring targets and identifying defence benefits from the Met Office's broader capability.

A customer group for the Met Office Hadley Centre Climate Programme already exists and is responsible for day to day management and delivery of the programme. It is responsible to the Programme Board, meets quarterly to review progress and comprises programme managers from the funding partners (DECC and Defra) and representatives from the Met Office and BIS.

The independent Met Office Hadley Centre Science Review Group (SRG) comprises UK and international experts appointed by DECC and Defra to review the quality, robustness and relevance of science outputs on an annual basis. We are exploring the options to co-ordinate SRG reviews with those of the Met Office Scientific Advisory Committee (MOSAC).

Since a programme assessment in autumn 2011, DECC and Defra have developed new governance arrangements, including SRG, Customer Group and Programme Board, the last will now also include BIS and is responsible for setting strategic requirements. The new governance structure also includes the formation of a Stakeholder Group. Formation of this group will form part of a Knowledge Integration strategy presented to the Programme Board for review. Members of the Stakeholder Group will represent organisations with an interest or involvement with the programme that are affected by its activities or outcomes. As such, it may include other government departments such as BIS (GO-Science), FCO, DFID, DfT, and DH; funding organisations such as NERC; and other related weather and climate initiatives. Once identified, the Stakeholder Group could become a focal point for



knowledge integration, dissemination of programme outputs, and targeted communication activities.

The new structure with the Public Data Group (PDG) and the DSB will formalise the relationships between Government and the Met Office. Departments will remain accountable for bi-lateral arrangements and the consideration of adopting the Customer Group model.

**6. We recommend that the Met Office continue to expand activities that generate commercial income; however, mechanisms must be in place to ensure that these activities do not put core services for the public sector or the Met Office's international reputation at risk. We invite the Met Office to explain in its response to us how this will be achieved.**

The Government agrees the Met Office should continue to expand activities that generate commercial income, for example through the development of innovative weather and climate services for the UK and overseas markets, but recognises these activities should not put core services for the public sector or the Met Office's international reputation at risk.

The corporate governance and accountability arrangements for the Met Office, described in the Met Office Framework Document, provide a strong framework for the Ministerial Owner, supported by the Met Office Board, to direct, scrutinise and challenge the business of the Met Office. The Shareholder Executive, in its role as sponsor, also provides support and a challenge function to the Met Office in developing profitable commercial revenue streams as well as facilitating cooperation between PDG members around commercial issues. These arrangements ensure there is an appropriate balance between the services the Met Office is required to provide in accordance with its top-level objectives—that is to the public and government, including the fulfilment of international obligations, as well as on a commercial basis—not least through the scrutiny and approval of the Met Office Corporate Plan which sets out the strategy for meeting these top-level objectives.

Met Office governance arrangements also include robust internal management processes and controls aligned to the delivery of the Corporate Plan, including mechanisms to ensure detailed scrutiny of any novel or contentious business proposals. In the case of the Met Office international strategy<sup>4</sup>, a steering group of senior managers from the relevant business areas ensures that the various elements of the strategy are joined up and provide maximum benefit as a whole. Under new reporting arrangements, from 2011–12 the Met Office Annual Report will include a governance statement to provide a comprehensive explanation of organisational governance, bringing together in one place all disclosures about matters relating to the Met Office's governance, risk and control. This is subject to external review by the NAO.

In addition, core government customers have detailed service level agreements which specify their requirements and set out negotiated outputs and delivery schedules. The Met

<sup>4</sup> The Met Office international strategy is focused on delivering three outcomes: to deliver the Met Office's international commitments and relationships it is required to as the UK National Met Service (NMS); to bring benefits from international science and technology partnerships and collaborations; and to grow profitable revenue from international activities. In practice, the growth of international business occurs organically through the strong relationships the Met Office has developed with other NMSs as a result of its international commitments and science partnerships. The Met Office's international reputation is enhanced by the fact it is seen as one of the best in turning world-leading science into services which benefit governments and industry around the world.



Office is also subject to considerable independent scrutiny, for example by the Public Weather Service Customer Group (PWSCG), MOSAC, and SRG. These groups provide important assurance about the quality and integrity of Met Office services and science.

The PWSCG will continue to provide expert advice to ministers through the DSB. The DSB will work to ensure the best value for money and quality of PWS products and services, including underpinning research and core science through PWS CSA, at the same time as ensuring Met Office contributes to stimulating the UK economy by making more of its core reference datasets available free at the point of use and re-use.

**7. Given the move towards integrating weather and climate science, and with the Met Office Science Advisory Committee's (MOSAC) remit being expanded to include both areas, we question whether it is sensible to impose additional scrutiny by the Met Office Hadley Centre Science Review Group (SRG). We recommend that the Met Office consult with DECC and Defra to determine whether the Hadley Centre SRG is required in its current form. Our view is that it would be more sensible to formally review all science under MOSAC, whilst retaining a Hadley Centre Climate Programme Customer Group, as described in paragraph 14, to ensure that customer needs are being met.**

The Government welcomes this recommendation, noting that for the first time this year the SRG will be meeting jointly with MOSAC and as noted earlier Met Office and customer departments are exploring options to co-ordinate SRG reviews with MOSAC's.

## Oversight of the Met Office

**8. We recommend that the Met Office publish MOSAC's terms of reference on its website. We also advise MOSAC to consider the Code of Practice for Science Advisory Committees (CoPSAC) at its next meeting, specifically considering whether MOSAC would benefit from adhering to the principles contained within it.**

The latest MOSAC terms of reference and current membership are now published on the Met Office website<sup>5</sup>.

MOSAC provides review and advice to the Met Office and its customers on the quality and relevance of its research programme, rather than providing science advice to inform government policy. However, MOSAC has committed to review CoPSAC at its next meeting, and ensure that it adheres to those principles where relevant.

## Models and Supercomputers

**9. Met Office models are highly regarded across the UK and around the world. It is a testament to the Met Office that its Unified Model is licensed to other national meteorological services. Collaboration with these international partners helps the Met Office to further test and develop its models and should be encouraged. Similarly, collaboration with the wider UK meteorology community should be encouraged to stimulate the development of Met Office models. We note that the MONSooN project has been held up as a particularly good example, providing a joint supercomputing**

<sup>5</sup> <http://www.metoffice.gov.uk/learning/library/publications/science/met-office-scientists/mosac>



system that allows scientists to collaborate on research into modelling issues. We encourage the expansion of MONSooN and recommend that NERC work closely with the Met Office to develop plans for the next phase that are suitable for the research community's needs.

The Government welcomes the Committee's endorsement of the Met Office's increasing collaboration with partners in the UK and internationally, and acknowledges the benefits that are derived. Gaining further benefit from these arrangements is a key aspect of the Met Office strategy, and will be progressed at the Met Office under the Head of Science Partnerships. A priority is redefining the licensing arrangements with National Met Services to enable stronger partnership working and to develop joint commitments to the technical support and ongoing development of the Unified Model. With NERC, the implementation of a joint strategy for Earth System Modelling will be achieved in the coming year. The Met Office Academic Partnership, designed to align research priorities and actions with the university community, is gathering pace and will be extended to other leading university groups.

The Government also welcomes the Committee's endorsement of the MONSooN collaborative supercomputing platform and is pleased to report that this facility has been expanded as part of the recent contracted Phase II upgrade to the Met Office supercomputer, and has also benefited from additional investment as part of the Government's e-infrastructure package. Plans for further expansion and development of MONSooN will be progressed with NERC via the Joint Weather and Climate Research Programme (JWCRP).

**10. It is of great concern to us that scientific advances in weather forecasting and the associated public benefits (particular in regard to severe weather warnings) are ready and waiting but are being held back by insufficient supercomputing capacity. We echo the recent conclusions of the Government Chief Scientific Adviser and others, that a step-change in supercomputing capacity is required. We acknowledge, however, that affordability is an issue. The Met Office has over recent years built a good case for increased investment. However, we have not in the course of our inquiry assessed investment in supercomputing over recent decades. We recommend that the Met Office provide an overview of historical investment in supercomputing resources in its response to us. We encourage BIS to complete a formal business case on supercomputing, however, we do not consider that this process should take anywhere near the 18 months suggested by the Government. In our view, the Government should finalise the business case in the next six months.**

The Committee's endorsement of the conclusions reached by the Government Chief Scientific Adviser and other reviews of the potential capability within the Met Office to provide improved weather and seasonal forecasts and climate predictions is welcomed.

The Met Office strategy for High Performance Computing (HPC) procurement is based on obtaining the best value for money in terms of performance and reliability, the latter being essential for a robust 24/7 operational system. Subject to affordability, it seeks to keep pace with international investments in HPC for weather and climate prediction so that the UK can retain its competitive edge and deliver services of increasing value to the UK both in terms of resilience to weather and climate hazards and economic benefits. In this context,



the Government is pleased to confirm that DECC and Defra have recently announced specific funding of £11.2 million for additional HPC hardware to deliver climate science and modelling for improved evidence for policy development, in particular to provide more reliable regional climate information on decadal and longer timescales.

In line with this strategy, the Met Office has regularly replaced its supercomputers to take advantage of improvements in technology so that increasingly complex numerical models of the weather and climate can be run, and the rapidly expanding multitude of weather and climate data from surface observations and satellites can be exploited. The following table shows supercomputer acquisitions over the last ten years, based on depreciation smoothed over asset lives, along with running costs. Values are adjusted to September 2011 price levels.

	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12
	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m
Annualised hardware capital spend (supercomputer and data archive)	3.9	5.8	6.3	6.3	6.3	5.6	3.4	6.1	5.4	2.7
Non-capital running costs (supercomputer and data archive)	4.5	7.1	6.4	6.3	6.6	7.2	6.7	5.8	6.1	5.4
<b>TOTAL</b>	<b>8.4</b>	<b>12.9</b>	<b>12.8</b>	<b>12.6</b>	<b>12.9</b>	<b>12.8</b>	<b>10.1</b>	<b>11.9</b>	<b>11.5</b>	<b>8.1</b>

*Note to table: the benefit of DECC/Defra's recently announced investment of £11.2 million in additional HPC hardware will be reflected in the annualised spend in 2012-13 and beyond.*

Through this strategy, the Met Office has been able to increase its supercomputing capacity (in step changes) at a long-term average rate of doubling performance about every 18 months over the period 1997–2012, compared to a doubling period of some 13 months for the Top500 international supercomputing facilities<sup>6</sup>. This has enabled the Met Office to make significant advances in weather and climate science and the delivery of operational services. However, as noted by the Committee, the Met Office currently has scientific advances available that are being held back by insufficient supercomputing capacity. Greater advances could be made with a more rapid increase in available capacity.

Current funding arrangements have forced an extension of the planned life of the current supercomputer to 2016/17. This is not considered ideal in terms of Met Office competitiveness and its ability to pull-through science to improved weather and climate services. The Met Office will therefore accelerate the development of its Business Case for the procurement of its next supercomputer in liaison with BIS and in compliance with HM Treasury *Green Book* principles. Within 6 months the Met Office will prepare the strategic outline case, produce the socio-economic investment appraisal, and identify potential partners. Subject to availability of funding, this would enable the Met Office to move quickly to the next stage of the process to identify a supplier via open market procurement and complete the full business case.

**11. Given that supercomputing capacity for weather and climate forecasting is a recurring issue, we recommend that the Met Office work with the Research Councils and other partners in the UK and abroad to develop a ten-year strategy for supercomputing resources in weather and climate. This should include an assessment**

<sup>6</sup> This is considered the most relevant and current international benchmarking comparator and shows that supercomputing capacity of the world's leading facilities is increasing faster than Moore's law predicted.



**of which areas in weather and climate research and forecasting might benefit from low-cost options to enhance supercomputing capacity.**

The Government acknowledges that there is a recurring requirement for additional supercomputing capacity for environmental prediction. It agrees that a long term strategy is required to ensure that the UK's investment in supercomputing keeps pace with that in environmental science, so that it maintains the UK's world-leading position in environmental prediction and realises the best possible economic benefit.

The Met Office is increasingly working in partnership with government customers, other government agencies and the Research Councils to develop operational services to advise both government and businesses of the risks and opportunities posed by our changing natural environment. This will enable mitigating actions to be taken against adverse conditions, reducing loss of life and costs to the economy, while increasing the ability to capitalise upon beneficial environmental conditions, contributing to economic growth.

As part of this collaboration the Met Office will work with NERC, government customers and other partners to assess the full requirement for supercomputing and produce a ten-year strategy to support both environmental research and operational delivery of advice and services. The strategy will consider, amongst other things, internationally available resources and opportunities for low-cost options, noting that such options have hitherto not offered a viable solution for the high-resolution models that the Met Office needs to run for operational purposes and the operational resilience it requires, as highlighted in the Met Office's written evidence. The strategy will be reviewed annually to ensure it keeps pace with emerging scientific research and technological advances.

## **Accuracy of forecasts**

**12. The Met Office is consistently within the top three centres internationally in weather prediction and is widely recognised as a world-leader in climate prediction. However, we note that the climate model did not accurately predict the extent of the flattening of the temperature curve during the last ten years. We have heard that the accuracy of short-term forecasts is easier to assess than the accuracy of longer term forecasts and infrequent events, such as volcanic ash dispersion. We encourage the Met Office to work with partners in the UK and internationally on developing metrics to assess the accuracy of longer-term forecasts of weather and climate and of forecasts based on infrequent events.**

The Government welcomes the Committee's encouragement for the Met Office to continue working with partners in the UK and internationally on developing metrics to assess the accuracy of longer-term forecasts.

The Met Office is already engaged in ongoing efforts in this area, and leads a number of activities. Work is underway at the Met Office, for example, to investigate approaches to extending the verification methods used for shorter-range forecasting out to longer ranges, which will aim to take advantage of the synergies offered by the 'seamless' Unified Model system in use across all timescales.



Met Office seasonal forecast skill scores are routinely published on its website<sup>7</sup> using internationally agreed statistics for the verification of probability forecasts as designated by the World Meteorological Organisation. Validating extreme events remains challenging, due to the limited number of previous events for a robust statistical assessment, but the Met Office is committed to continue assessing the model performance of predicting individual extreme events through conducting ad-hoc case studies with international partners. It also seeks to ensure that the observational infrastructure is in place to initialise, constrain and evaluate forecasts of extreme events. An example is the current investment in upgrading the UK radar network in cooperation with the Environment Agency.

The Government also welcomes the Committee's encouragement for the Met Office to continue efforts on the validation of atmospheric dispersion forecasts. This is part of an ongoing programme of work, necessarily involving validating the NAME output either against a number of dedicated field experiments (e.g. ETEX) or real-world events (e.g. Eyjafjallajökull, Grimsvotn, Chernobyl, Fukushima, Buncefield, etc). The Met Office is also involved in a number of international inter-model evaluation exercises. Model validation exercises are also routinely published by the Met Office in the peer-reviewed literature.

The Met Office is one of just a handful of centres worldwide which provide critical observational datasets and monitoring of long-term global trends. This provides vital information about how the climate has changed over many years and shows that despite variability from year to year—which sees periods of faster and slower warming—a clear underlying trend of increasing global temperature can be seen in the observation records from the late 1970s onwards.

Significant advances have been made in climate modelling since the 1990s. The Met Office decadal forecast system, for example, was introduced in 2007. When run retrospectively it produces temperature trends consistent with observations. In this context, free running climate projections, as available in the 1990s, would not be expected to represent observed trends during a particular decade, but do simulate some decades with faster and slower rates of warming due to natural climate variability<sup>8</sup>. Developing and improving decadal forecasting services is a key element of the Met Office's Science Strategy to enable improved operational planning across all sectors that are vulnerable to variations in weather and climate. To this end, the recently announced extra funding support for HPC from DECC and Defra will significantly enhance Met Office Hadley Centre's capability to deliver improved decadal and longer term climate projections.

## Communication of forecasts

**13. The Met Office should continue to produce longer term (“seasonal”) forecasts as they are useful for civil contingencies and a wide range of industries. These forecasts should always be communicated carefully and accompanied by explanatory notes**

<sup>7</sup> <http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/gpc-outlooks/glob-seas-prob-skill>

<sup>8</sup> On decadal timescales changes in climate are caused by a combination of factors, such as anthropogenic changes in atmospheric greenhouse-gas and aerosol concentrations; natural variations in volcanic and solar activity; and natural, unforced internal variability. To predict regional changes on these timescales it is important to include all of these effects. The Met Office's decadal predictions system achieves this by starting predictions from observed atmospheric and oceanic conditions, and including projected emissions of greenhouse gases and variations in natural climate forcings such as solar activity. By contrast, free running climate projections are not initialised with latest observations and therefore provide advice on trends over longer timescales.



**describing the uncertainty. We recommend that the Met Office develop a communications strategy that sets out, for example, how it intends to enhance the ways in which it presents probabilistic weather forecast information.**

The Government welcomes the Committee's endorsement of the Met Office's long-range forecasting capability and recognises the considerable benefit that reliable extended-range forecasting can bring to operational decision-making, resilience planning and infrastructure investments. The Met Office will continue to push forward the science in this area, working for example with partners to improve its understanding and representation of key factors that give predictability in longer-range forecasts, such as El Niño, Arctic sea ice, and solar variability.

The Government agrees these forecasts should always be communicated carefully and accompanied by explanatory notes describing the uncertainty. The Met Office 3-month outlook for the contingency planning community, for example, is accompanied by extensive user guidance<sup>9</sup> including information on uncertainty and how best to use these forecasts in conjunction with other information provided by the Met Office including shorter-range forecasts and weather warnings.

Recognising the increasing use of probabilistic information in weather forecasts across all timescales, the PWSCG has asked the Met Office to produce a report during 2012–13 outlining expected science developments over the next five years, with implications and recommendations for product and service development, together with an accompanying communications strategy. As part of this, the Met Office will consider how it can better tailor its longer range weather forecast to the needs of local and regional emergency responders.

**14. The Met Office should also work closely with broadcasters, such as the BBC, to ensure that forecasts are communicated accurately. In particular, we are keen to see broadcasters make greater use of probabilistic information in their weather forecasts, as is done in the United States. Broadcasters should also make more use of digital technology to ensure that probabilistic forecast information is available to those that want it.**

The Government agrees that greater use should be made of probabilistic information in weather forecasts. The Met Office recognises the importance of probabilistic information and has invested heavily in the science of ensemble forecasting over several years to provide a strong science basis for representing the predictability of the weather forecast. The Met Office is also engaged in various pieces of work with partners to understand how the public interprets and uses probabilistic information so that it can design the most suitable products and services.

Last summer, for example, the Met Office began an extensive research project using an online game to understand how best to present probabilities in weather forecasts. Carried out in collaboration with the Universities of Bristol and Cambridge, the game was played more than 11,000 times providing a wealth of valuable data. Early results showed that people make better decisions when provided with more complex uncertainty information.

9 [http://www.metoffice.gov.uk/media/pdf/g/o/3-month\\_Outlook\\_user\\_guidance-150.pdf](http://www.metoffice.gov.uk/media/pdf/g/o/3-month_Outlook_user_guidance-150.pdf)



The data are currently being analysed and the intention is for the full set of results to be published in peer reviewed journals, with the underlying dataset made available online.

The Met Office is also working with the BBC to improve the communication of probability and uncertainty in weather broadcasts. For example, trials were conducted in December 2011 and February 2012 providing alternative scenarios to highlight uncertainty around the detail of 2 impending high impact weather events—the track of a storm and the location of snowfall respectively. Additional supporting information was provided on the Met Office and BBC websites. This work will be taken forward and continue to be developed in the coming months.

In addition, the PWSCG will be undertaking a consultation exercise on risk and probability during 2012–13, drawing on a range of scientific studies, and delivering recommendations for the Met Office to consider.

Through this work and building on the lessons learned, the Met Office, in conjunction with its partners, is committed to build on the probability information already available on its website and develop a greater range of probabilistic services across all available channels.

Met Office will also look to see how it can use other channels of communication to ensure that its data and services are available to the broadest possible audience. This will also include releasing, where appropriate, further data and services available through the PWS in as open a way as possible, including through Open Data.

## Access to data

**15. We note that there are contrasting views on how easy it is to gain free access to Met Office data. While we take some reassurance from the fact that the Met Office tries to address specific concerns about this as and when they arise, we consider that the current consultation in collaboration with the Royal Meteorological Society on access to data should help the Met Office to deal with the problem in a more strategic manner. We recommend that the Met Office also look to other countries for best practice on making data more freely available. Alongside this, we welcome the Government's initiative under the Public Data Corporation to make more Met Office data available to drive innovation and growth. The Government should continue to work with the Met Office to ensure that the new arrangements are effective and do not add an unnecessary level of bureaucracy.**

The Met Office is committed to making more weather and climate information available in formats that are useful to the public and give users the opportunity to create innovative, exciting ideas and applications. This includes making its data available as open data where appropriate. For example, automated forecasts for 5,000 sites are now available in reusable format through the Met Office DataPoint web service<sup>10</sup> following commitments in the Autumn Statement 2011. In addition, the Met Office Weather Observations Website<sup>11</sup> (WOW) provides a cloud based platform for sharing current weather observations and now receives over 2.5 million weather observations every month and is visited by weather

<sup>10</sup> <http://www.metoffice.gov.uk/public/ddc/>

<sup>11</sup> <http://wow.metoffice.gov.uk/>



enthusiasts in 145 countries. The Met Office is also hosting the European event for the NASA Space Apps Challenge<sup>12</sup>, which will focus on the development of new and innovative ways to mix weather and climate data available via the Met Office DataPoint website with other data sets in ways that add value. These initiatives are building on the large quantities of Met Office data which are already available for free or at marginal cost. In future, the Met Office will work with the DSB and the Open Data User Group to best design the ways in which it increases access to its data.

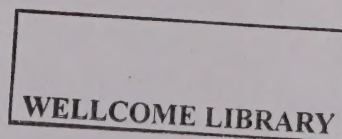
The Government announcement of the set up of the Data Strategy Board (DSB) and the PDG of Trading Funds and their respective roles should serve as the vehicle to ensure that Met Office data is made more freely available for long-term economic and social benefit and with minimum bureaucracy. The strategic focus on the DSB will ensure that requests for data released from the Met Office will be considered on the balance between the value to users of the data and potential growth opportunities across the range of data sets from the PDG of Trading Funds but also on the impact on the Met Office's operational and commercial responsibilities.

The DSB will initially focus on maximising the value of data from the PDG of Trading Funds: Companies House, HM Land Registry, Met Office and Ordnance Survey. The DSB will work alongside the PDG which will seek to support growth in the UK economy by delivering efficiencies and improvements in public services through its members. Terms of reference for both Groups were announced on Monday 19<sup>th</sup> March and the announcement included details of how they relate to each other.

## Working in Partnership

**16. We recommend that the Government consult with the Met Office on the need for Government representation on Met Office science partnerships. While such representation may be desirable to ensure strong links between the Government and policy-relevant research, care must be taken to ensure that there is no conflict with the Haldane principle—particularly where partnerships are co-funded by the Research Councils.**

The Government has consulted with the Met Office on the need for Government representation on Met Office science partnerships. While the need for such representation has not arisen to date, there may be some collaborations of a strategic nature that emerge where departmental representation might be of value. In any such case, the Met Office will liaise closely with the affected department(s) and agree an appropriate level of representation and, where relevant, ensure that there is no conflict with the Haldane principle.



12 An initiative of the Open Government Partnership, the International Space Apps Challenge will showcase the impact that people working together around the world can have on addressing challenges, both on earth and in space, by using open government data resulting from space technology (<http://spaceappschallenge.org/>)



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